



ELECTROCARDIOGRAM

How to read an ECG (in 10 steps)

@MD,Sun Bunlorn Page

Check: Calibration - 25 mm/sec

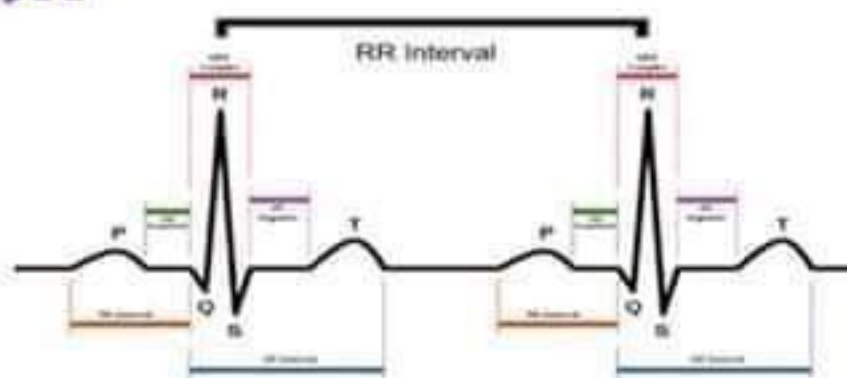
1. Rhythm

2. Rate

3. Axis

4. P wave

5. PR interval



6. Q wave

7. QRS complex

8. QT interval

9. ST segment

10. T wave

1. Rhythm

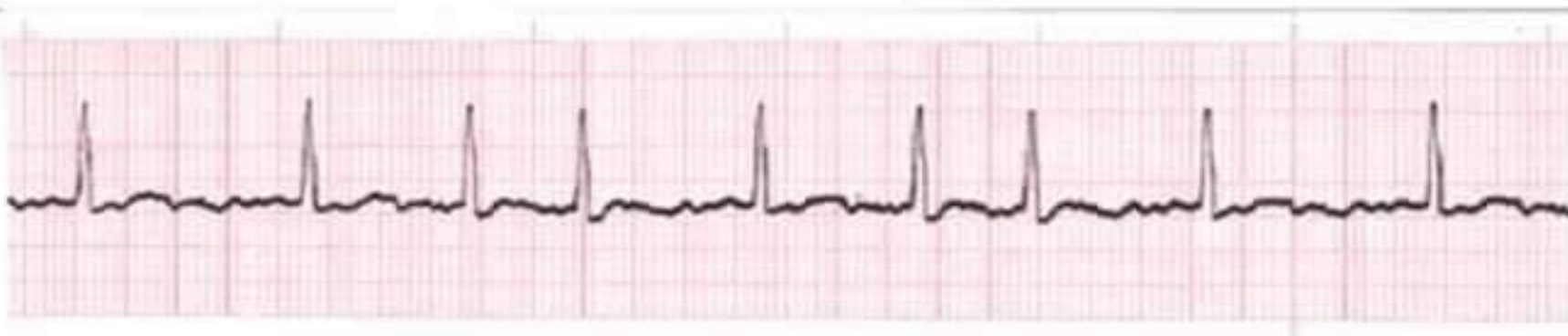
Regular rhythm

(NORMAL SINUS RHYTHM)



Irregularly Irregular

(Atrial Fibrillation)



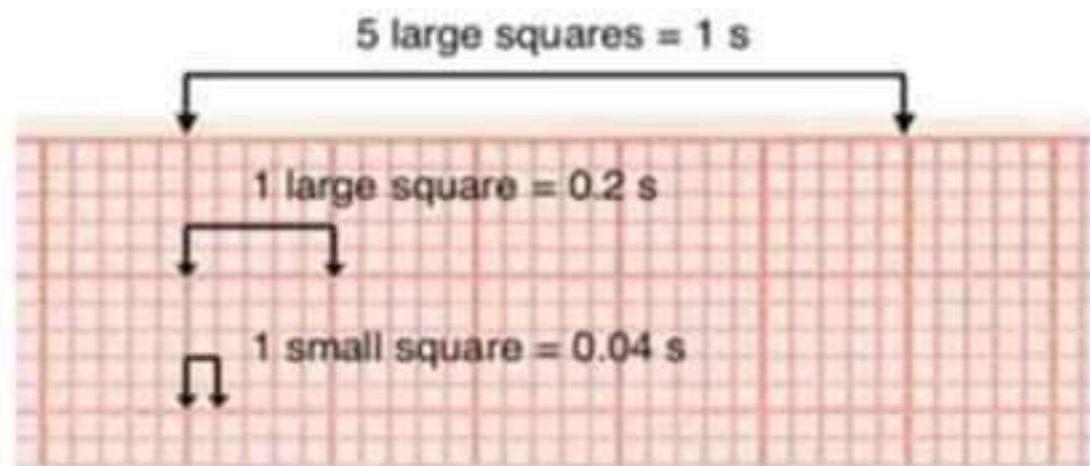
Regularly Irregular

**(Second degree heart block)
type 2**



2. Rate

$$\text{Regular rhythm} = \frac{300}{\text{R-R interval (large boxes)}}$$

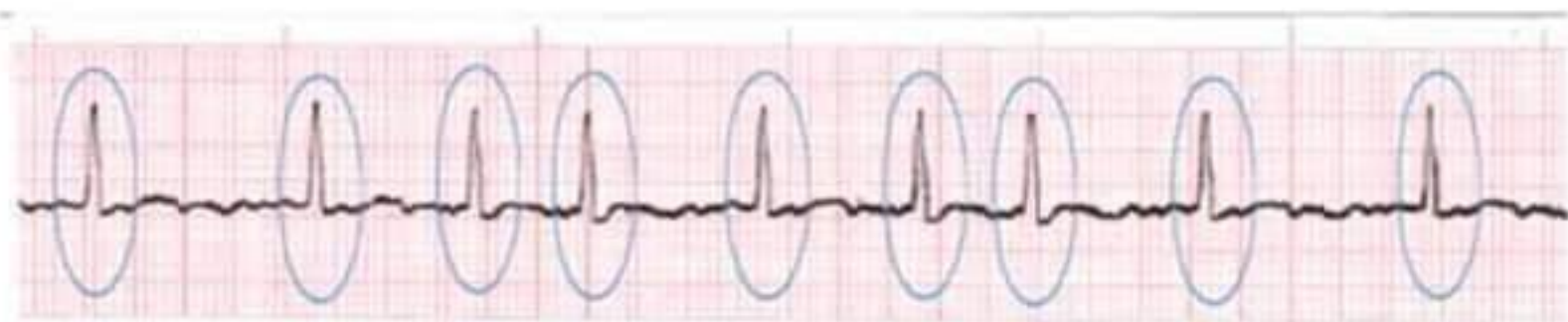


$$\text{Rate} = 300/4$$
$$= 75 \text{ bpm}$$



$$\text{Irregular rhythm} = \text{No. of R waves in 6 sec} \times 10$$

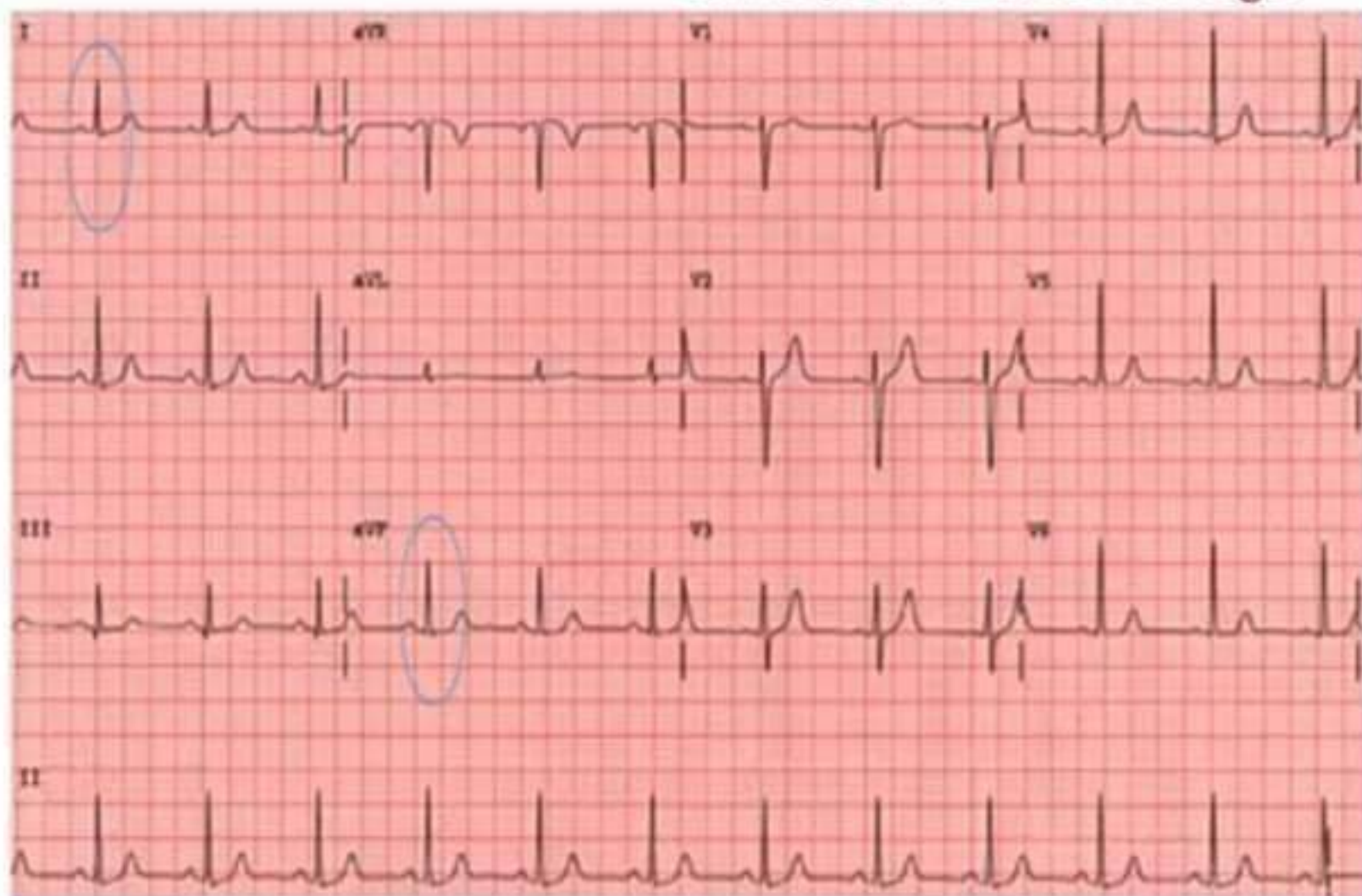
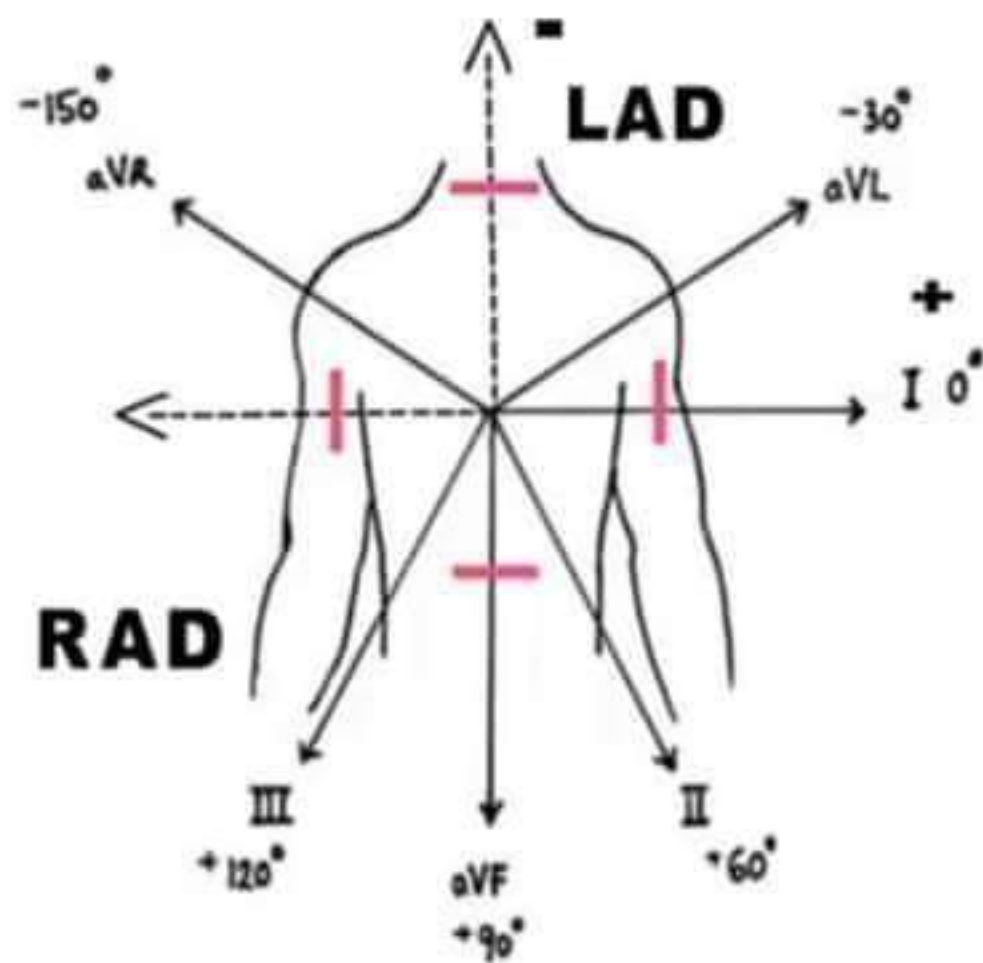
$$\text{Rate} = 9 \text{ R-waves} \times 10$$
$$= 90 \text{ bpm}$$



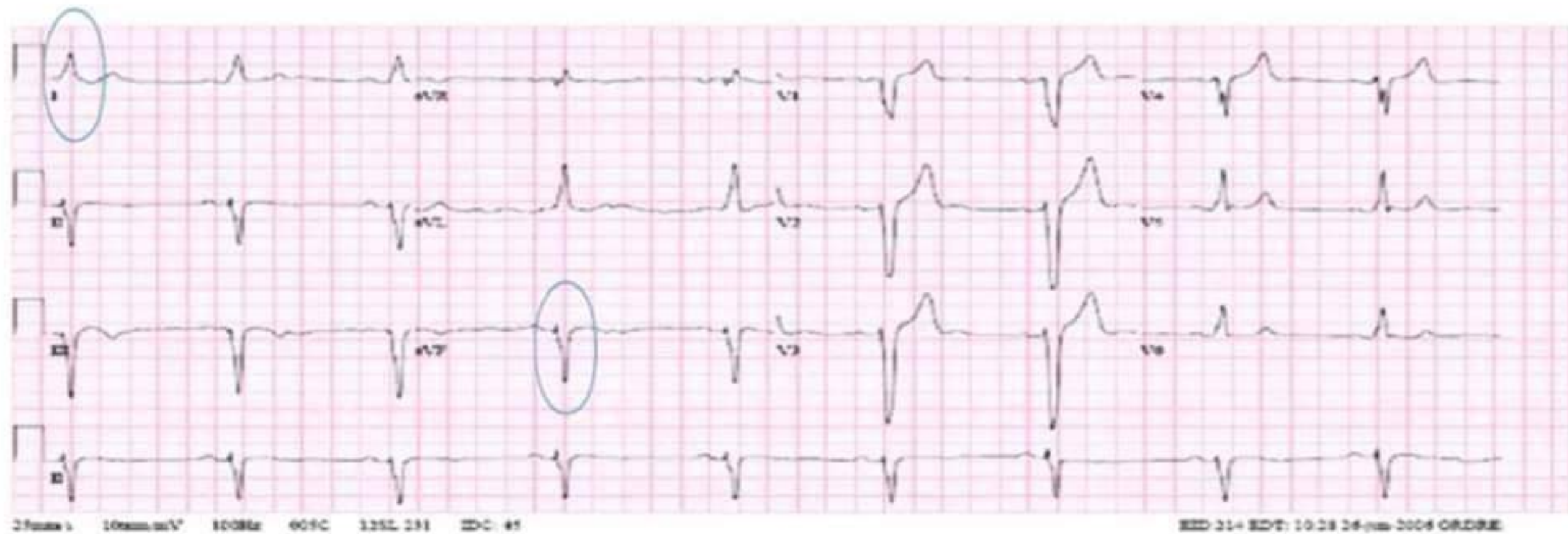
3. Axis

Normal cardiac axis is -30° to $+110^{\circ}$

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Normal Axis



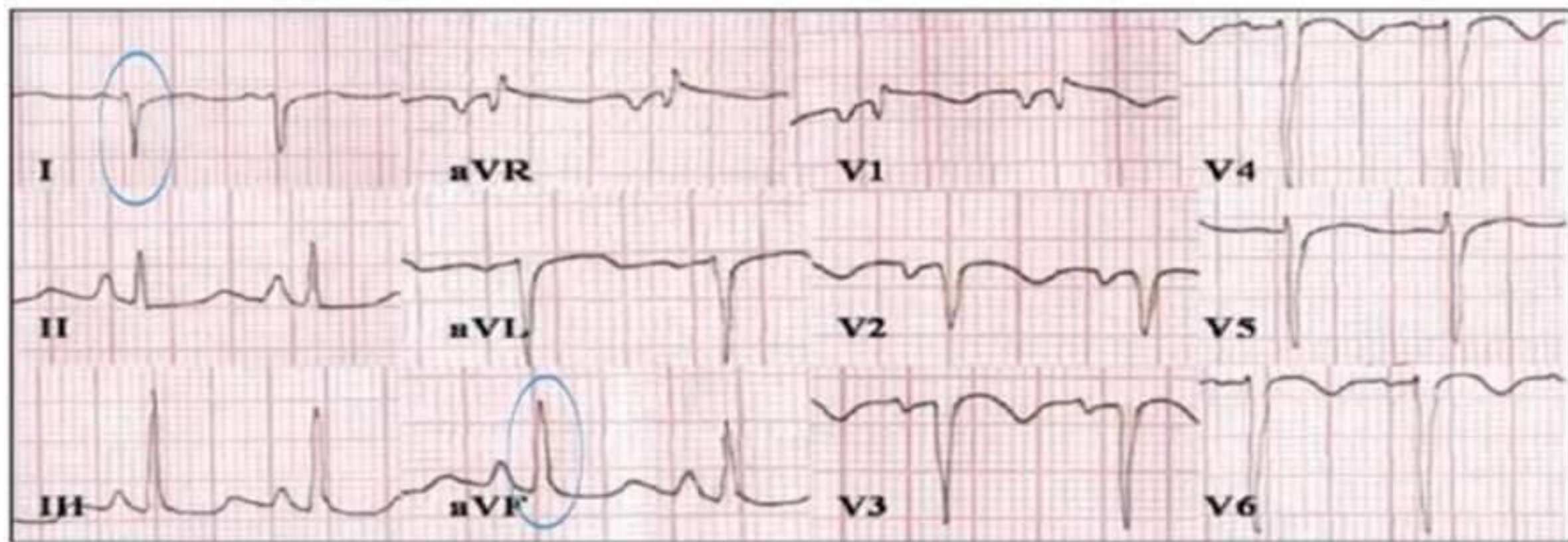
LEFT AXIS DEVIATION (LAD)

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Mnemonic
Left - Leaves

I ↑

aVF ↓



RIGHT AXIS DEVIATION (RAD)

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Mnemonic

Right- Returns

I ↓

aVF ↑

4. P wave

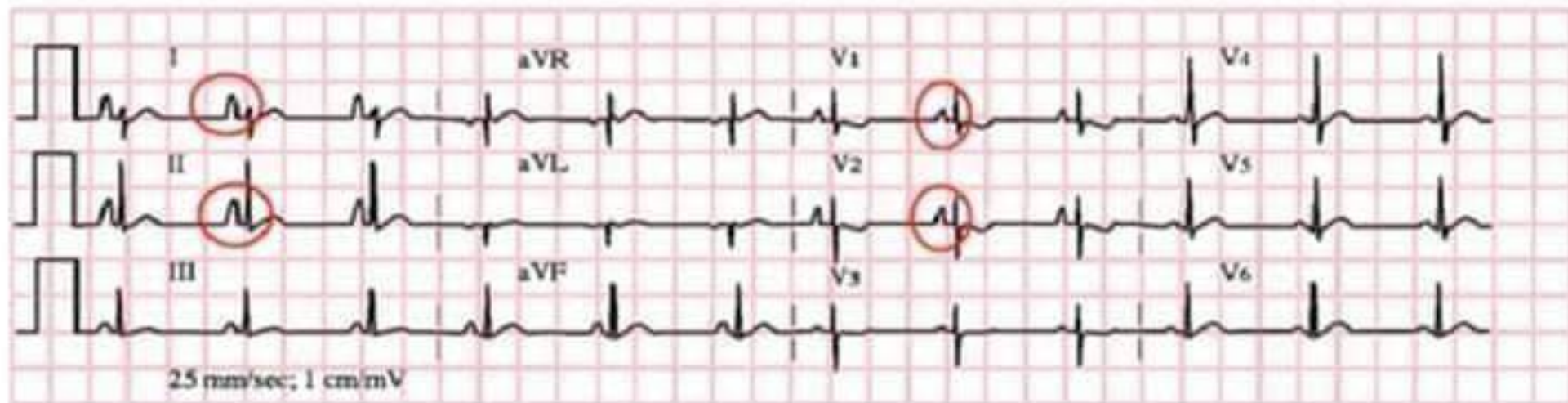
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Height $< 2.5\text{mm}$ (lead II)
 $< 1.5\text{mm}$ (v1)

Width $< 0.12\text{ sec}$

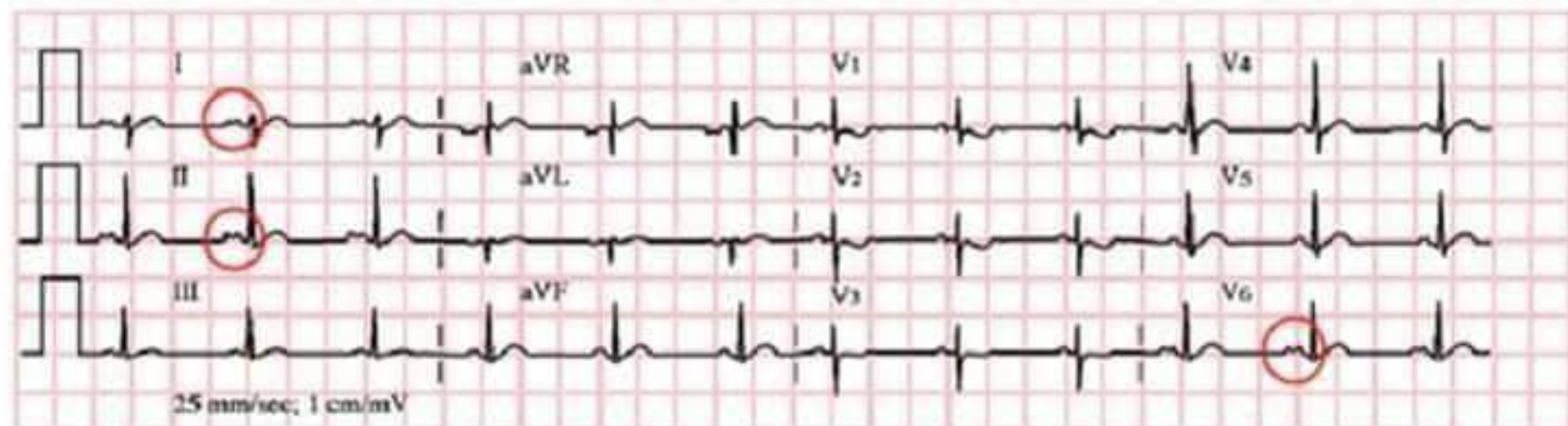
P- Pulmonale

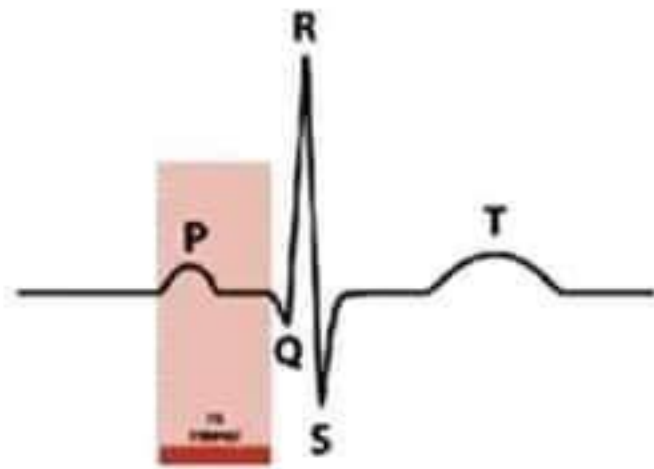
Right atrial enlargement



P- Mitrale

Left atrial enlargement





5. P-R interval

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0.12 - 0.2 sec (3-5 small squares)

Prolonged: **A-V blocks**



Reduced: **WPW syndrome**

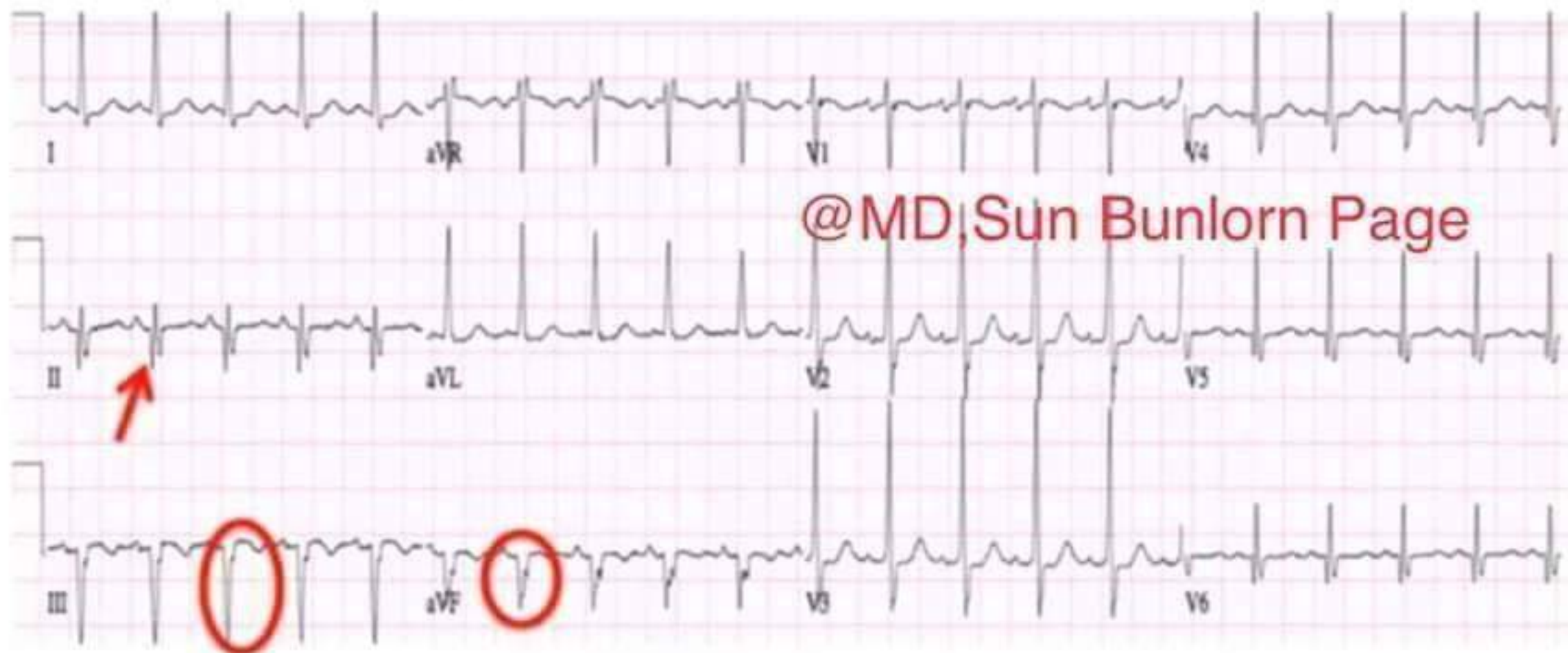


Depressed: **Pericarditis**



6. Q wave

Pathological: >2 small squares deep



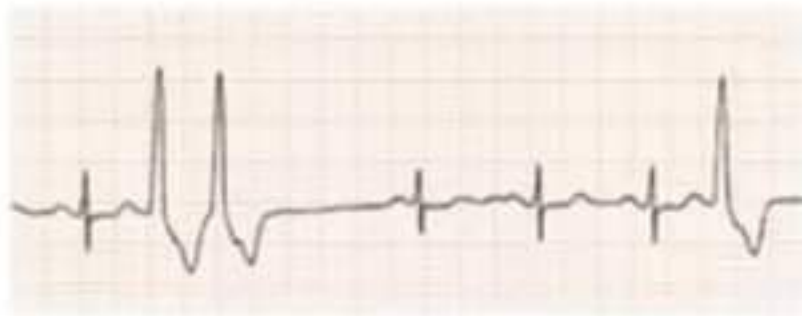
Old Inferior wall MI

7. QRS complex

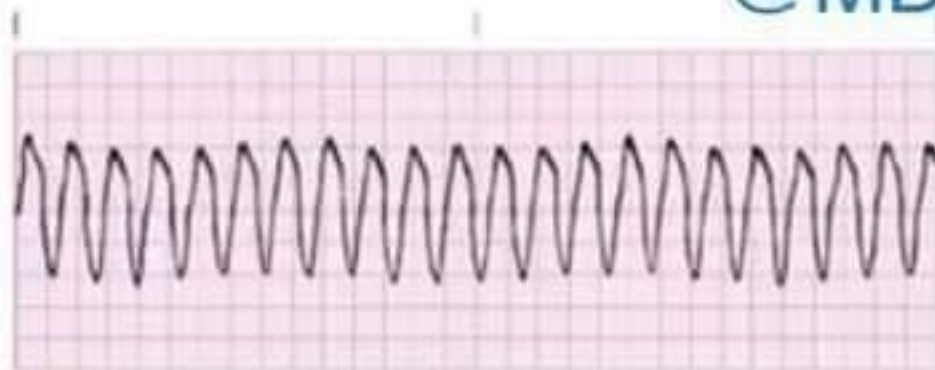
0.08-0.12 sec (2-3 small squares)

BROAD QRS **Ventricular arrhythmias**

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**Ventricular
Ectopic**



**Ventricular
Tachycardia**



**Ventricular
Fibrillation**

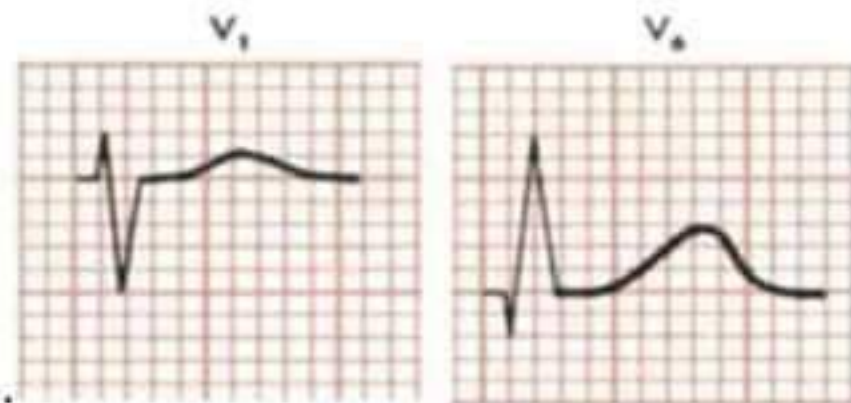
Bundle Branch Blocks

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V1 MARROW **V6**

V1 WILLIAM **V6**

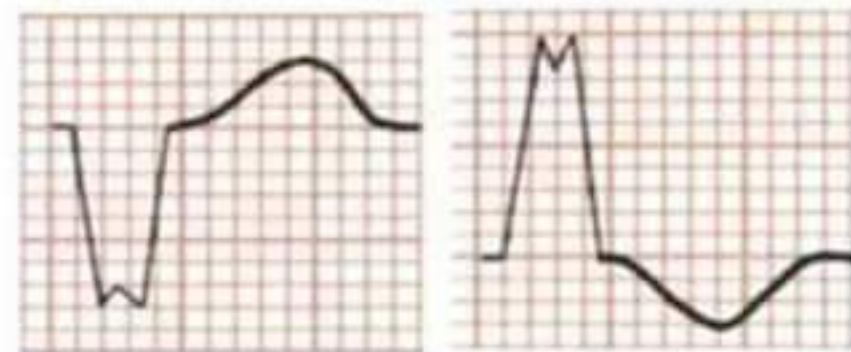
NORMAL



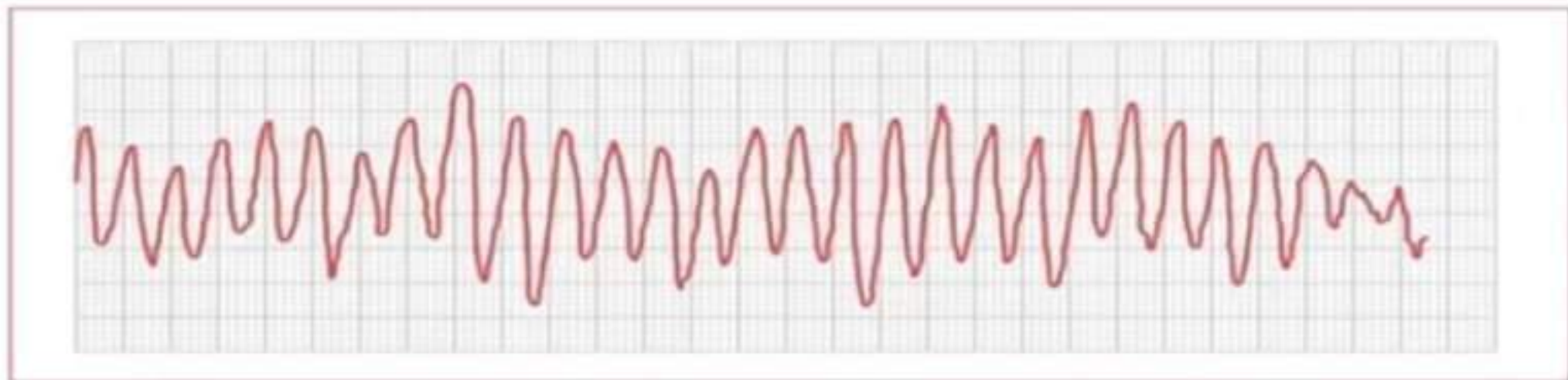
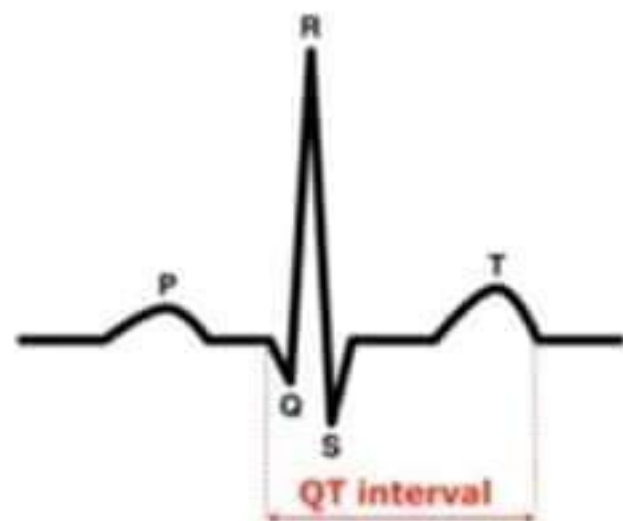
RBBB



LBBB

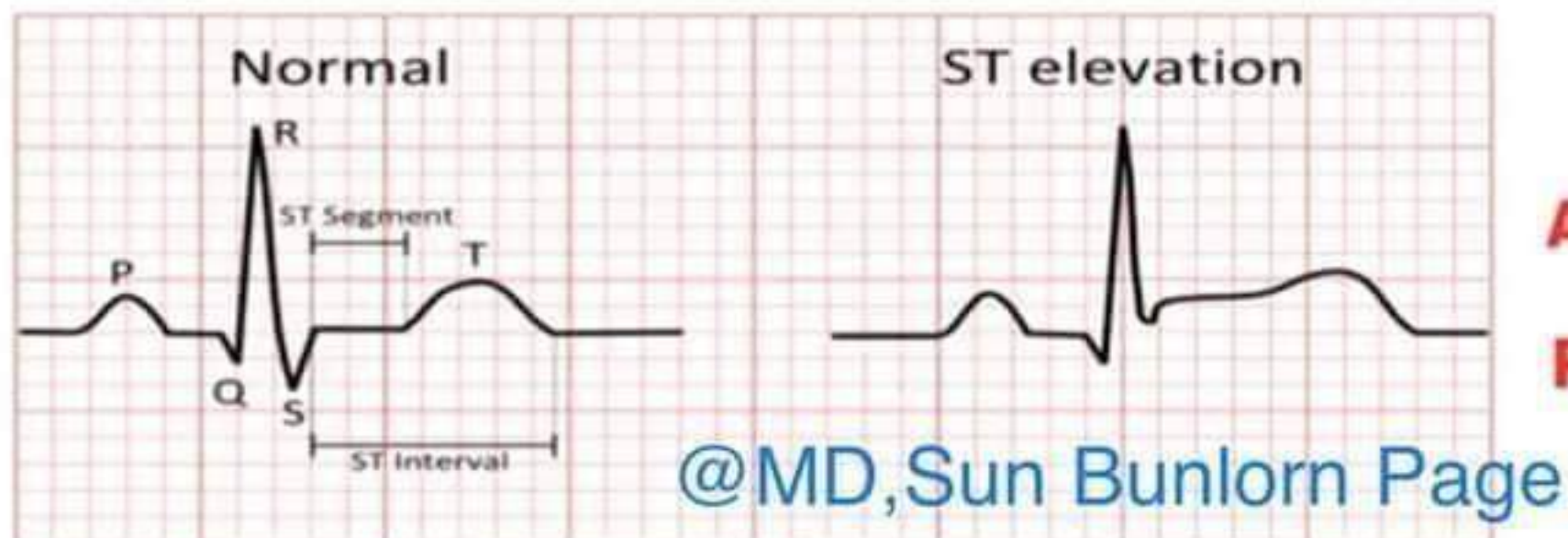


8. Q-T interval



TORSADES DE POINTES

9. ST segment



Acute Myocardial infarction

Pericarditis

V1,V2: Septal wall MI

V3,V4: Anterior wall MI

I+aVL, V5V6: Lateral wall MI

II, III ,aVF: Inferior wall MI



NSTEMI
Myocardial Ischemia
Posterior MI

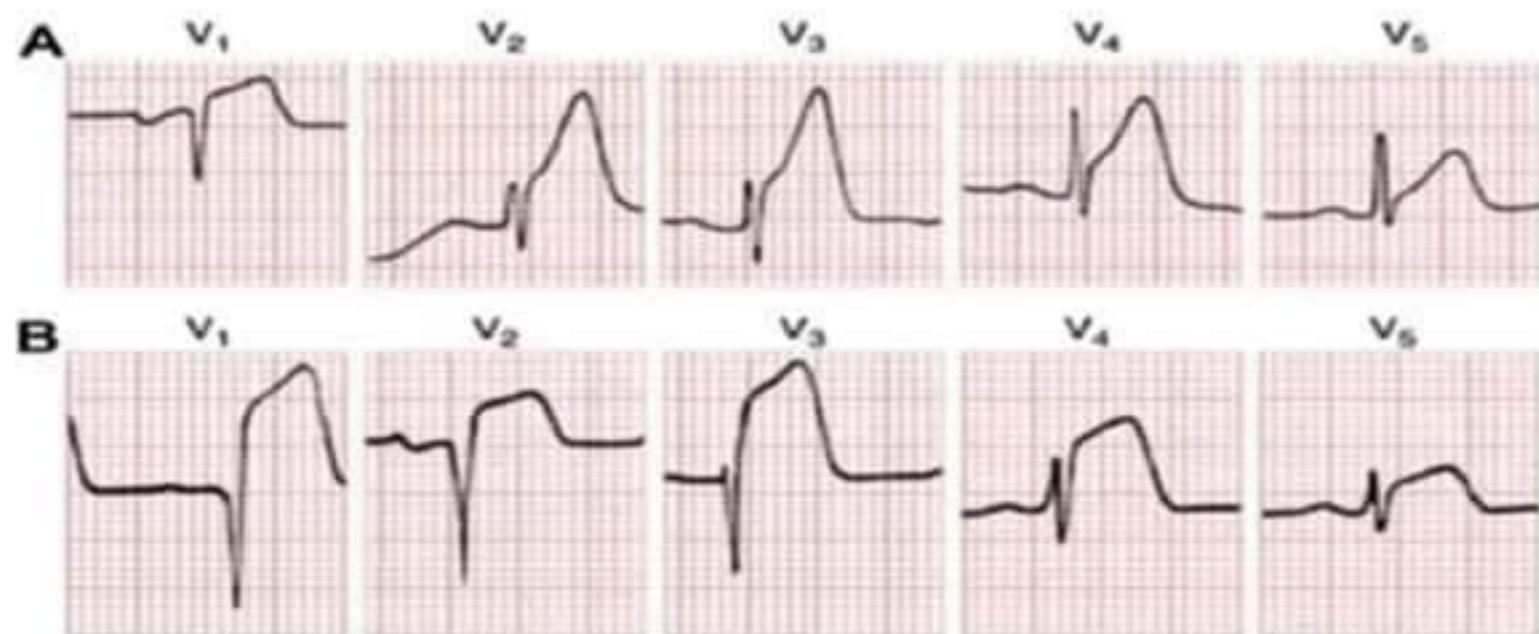
10. T wave

Upright in all leads except aVR & V1

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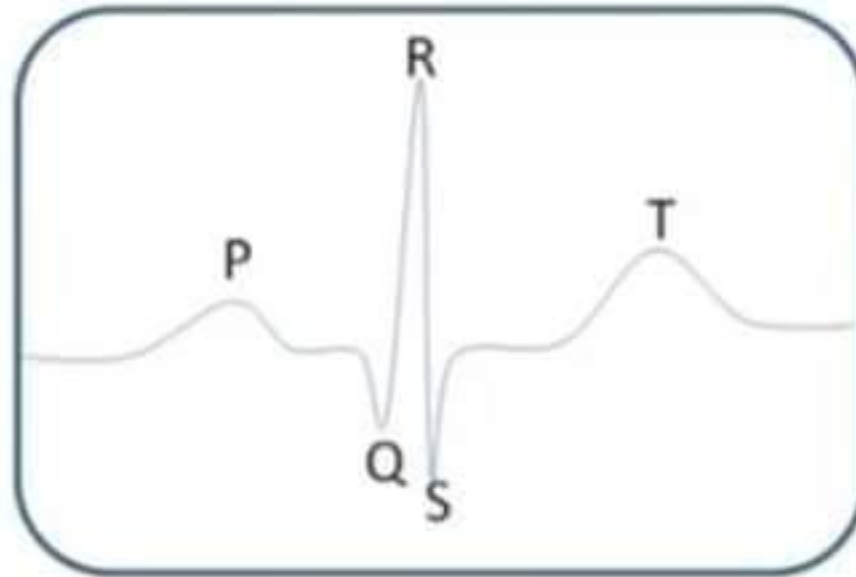


Peaked T waves
Hyperkalemia

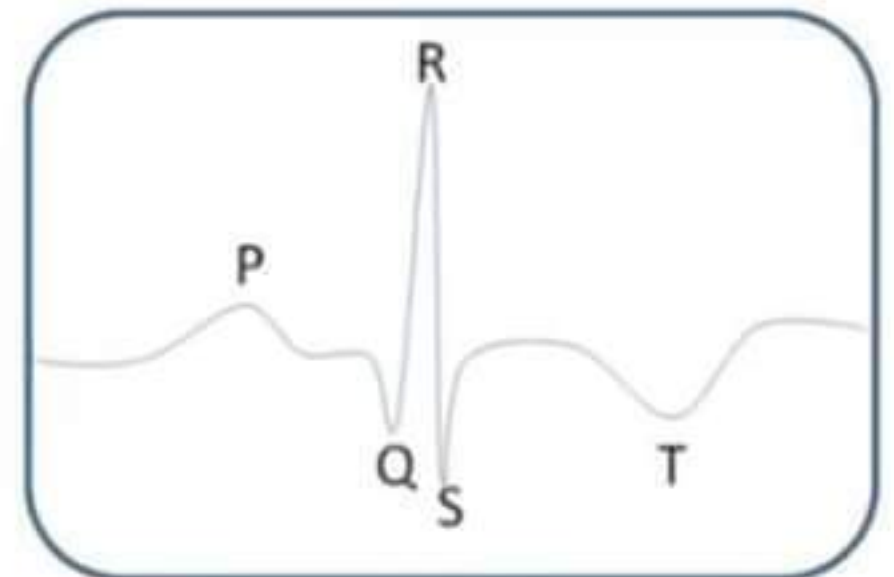


Hyperacute T waves
Early STEMI

Inverted T wave



An ECG showing the normal P Q R S T waves



An ECG showing an inverted T-wave

Myocardial Ischemia

Ventricular Hypertrophy

Left Ventricular Hypertrophy



Sokolow-Lyon Criteria: Add the deepest S wave in V1 or V2 plus the tallest R wave in V5 or V6. If the sum is > 35 mm, then LVH is present.

Right Ventricular Hypertrophy



Right Axis Deviation

$R/S > 1$ in V1

< 1 in V5V6

$R(V1) > 7$ mm